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Tremelloscypha gelatinosa (*Sebacinales*) from tropical deciduous *Gymnopodium* forests in southern Mexico

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Abstract — Populations of *Tremelloscypha gelatinosa* were found growing on the soil in *Gymnopodium floribundum* associations of the tropical deciduous forest in southern Mexico (State of Chiapas). Documentation of the different developmental coriaceous and spongy stages revealed a widely variable gross morphology that ranges from stipeless pulvinate forms to rudimentarily stipitate pseudoinfundibuliform forms that appear polyporoid, steroid, or gomphoid. The studied collections are described and their taxonomically distinctive macro- and micromorphological characters are illustrated. The possible mycorrhizal association of *T. gelatinosa* with *Gymnopodium floribundum* and traditional use of the basidiomes as a wild edible fungus by the local population are also discussed.

Key words — edible mushrooms, *Sebacinaceae*, taxonomy, tropical fungi

Introduction

During the last few years we have sampled ectomycorrhizal macromycetes within the *Gymnopodium floribundum* Rolfe (*Polygonaceae*) association, a type of tropical deciduous vegetation established in the Central Chiapas basin (State of Chiapas) in southern Mexico [Miranda 1952, as *G. antigonoides*; Reyes-García & Souza 1997]. Several species of *Amanita*, *Cantharellus*, *Russula* and other ectomycorrhizal genera have been found, all possibly associating with *G. floribundum*. *Lactarius chiapanensis* Montoya et al. was previously recorded from this ecosystem (Montoya et al. 1996) and recently several new fresh collections were gathered.

An interesting find in the *Gymnopodium* forest was numerous specimens of a fungus with coriaceous soft spongy rudimentarily stipitate sporophores. Mature specimens, which were somewhat trumpet-shaped, resembled a stout *Gomphus* species. After examination, we identified these specimens as

Tremelloscypha gelatinosa, a heterobasidiomycete related to members of order *Sebacinales* M. Weiß et al. (Weiß et al. 2004a). Molecular-based studies indicate that *T. gelatinosa* belongs to *Sebacinales* group A and is phylogenetically related to proven ectomycorrhizal species (Weiß & Oberwinkler 2001, Weiß et al. 2004a, Selosse et al. 2002). There is still no documentation about the mycorrhizas of *T. gelatinosa*, but its phylogenetic placement among recognized ectomycorrhizal sebacinoid species suggests that it could be a potential fungal symbiont of plant roots (Glen et al. 2002, Selosse et al. 2002, Urban et al. 2003, Weiß et al. 2004a,b). Considering the abundance of *T. gelatinosa* and its possible ectomycorrhizal status in the *Gymnopodium* forest that we visited, we collected mycorrhizas from soil samples, including some occurring directly under *T. gelatinosa* sporophores. Morphological examination revealed the constant presence of at least two different morphotypes, but as PCR amplification from extracted genomic DNA failed, it was not possible to determine whether the collected mycorrhizas involved *T. gelatinosa* or other fungi. New collections of root tips of *Gymnopodium floribundum–Tremelloscypha gelatinosa* will be studied in the future.

Tremelloscypha gelatinosa is rare not only in Mexico but also worldwide, and its morphological variation still deserves to be documented and illustrated. Therefore we present important information on the extent of morphological variation exhibited by fresh basidiomes collected at different developmental stages. Today the species concept of *T. gelatinosa* is based on the type specimen (a portion of a basidiome) and some single collections from Jamaica (type locality), Florida (USA), Yucatan and Quintana Roo (Mexico) (Burt 1915, Guzmán 2004, Roberts 2006, Wells 1961, Wells & Oberwinkler 1982). Here we describe our new collections in detail, providing photographs and illustrations of basidiomes and distinctive micromorphological characters and taxonomic observations.

Tremelloscypha gelatinosa is an economically valuable wild edible fungus in the Central Chiapas basin, particularly near Tuxtla Gutierrez, Chiapas. In this region *T. gelatinosa* is locally known as "nangañaña" and —with the so-called "moni" *Lactarius chiapanensis* (first reported by Miranda 1952 and formally described by Montoya et al.. 1996)— is commonly collected by the local population for personal consumption and/or for sale. *Gymnopodium floribundum* is a dominant or co-dominant species in the deciduous tropical forest established at SE of Tuxtla Gutierrez (Miranda 1952, Reyes-García & Souza 1997); the *G. floribundum* forest, which (although now fragmented) covers several hectares, is collectively called "nangañal" ("aguanal" or "aguanacatonal" in Miranda 1952). More will be published on traditional use of *T. gelatinosa* in the future.

Materials & methods

Observations were made from fresh basidiomes collected in a forest dominated by *Gymnopodium floribundum*, a tropical deciduous component of vegetation in Suchiapa, municipality of Suchiapa, SE of Tuxtla Gutierrez, Chiapas. Color codes in descriptions refer to Kornerup & Wanscher (1967; e.g. 10C2) and Munsell (1994; e.g. 5YR 4/1). For microscopic observations, hand sections of dried samples were mounted in 3% KOH and stained with both 1% Congo red aqueous solution and phloxine. Line drawings were made with the aid of a drawing tube. Measurements were made in KOH; 35–45 spores were measured per collection; *Xr* = range of means of length × width of n collections; *Qr* = range of means of basidiospore length/width ratios in n collections. Herbarium acronyms follow Holmgren et al. (1990).

Identification of collection VB4212 was confirmed by extraction and amplification of the ITS rDNA region according to Montoya et al. (2010). The obtained sequence was edited with Sequencher Ver. 4.1 (Gene Codes, Ann Arbor, Michigan) and deposited in GenBank database (http://www.ncbi.nlm.nih.gov/) under accession number *T. gelatinosa* (VB 4212) JQ012947. The ITS rDNA sequence from VB4212 was compared with *T. gelatinosa* AF490394 (GenBank) using the BLAST sequence similarity search tool (Altschul et al. 1997), revealing a 99% maximum similarity.

Taxonomy

Tremelloscypha gelatinosa (Murrill) Oberw. & K. Wells,
Mycologia 74: 325, 1982. Plates 1–4

≡ *Eichleriella gelatinosa* Murrill, Ann. Missouri Bot. Gard. 2: 748, 1915.

Basidiomes (25–)40–165 × 30–110 mm, pulvinate or irregularly subglobose in young stages, becoming more or less trumpet-shaped in profile and then pseudoinfundibuliform, rudimentarily stipitate, soft and spongy when wet but coriaceous and even fibrous in dried condition. Pileus (25–)40–165 mm wide, subglobose, gradually plano-convex, plane and finally plane-depressed (not deeply depressed or perforated), then pseudoinfundibuliform, irregularly circular, frequently becoming flabellate or spathulate, often confluent forming an irregular mass of spathulate or flabelliform pilei, with somewhat crenate or more or less lobed margin, this latter thin or broad, slightly elevated, obtuse; surface dry, zonate, at first velvety, with age appearing fibrillose, villose or strigose, at times somewhat floccose-scaly (mainly in old specimens); whitish or grayish when young, at times whitish with pale gray-blue or pinkish areas, becoming brown-yellow, brownish (5D5–7), brown-reddish or brown-orange (6D4–6), rarely with greenish shades, with darker concentric zones (6E6–7, 6F5–6), in dried material pale brown to brown, with spongy aspect, dry; margin whitish becoming brownish or paler, in some stages showing pale vinaceous tinges. Hymenophore decurrent, smooth, plane to irregularly rugulose or with short bulges, then at times appearing faintly verruculose, continuous, rarely cracked, cartilaginous in aspect, tough when dried, whitish or with yellow to

Plate 1. *Tremelloscypha gelatinosa*. (a: Bandala 4210; b: Bandala 4212). Scale bar = 20 mm.

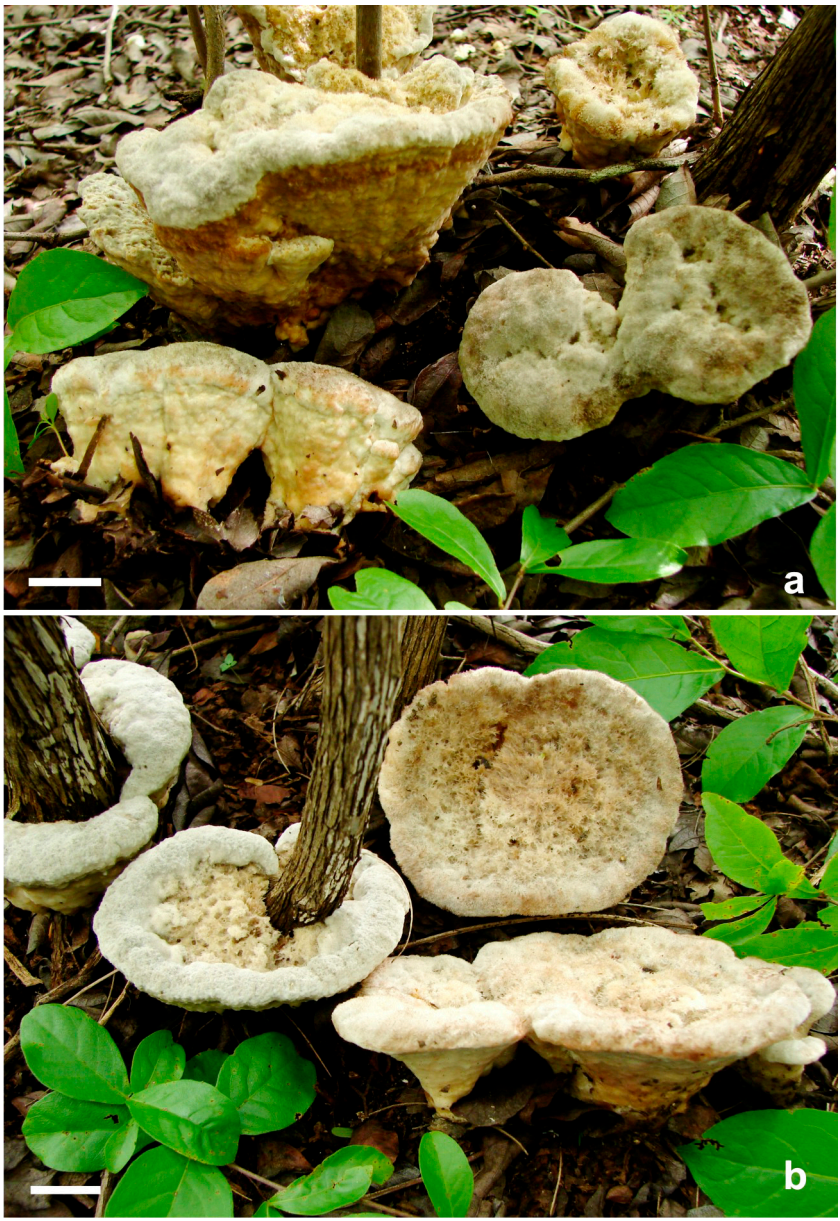

Plate 2. *Tremelloscypha gelatinosa*. (a: Bandala 4361; b. Bandala 4363). Scale bar = 20 mm

gray tints (5YR 4/1), dark or light grayish-vinaceous (9D3, 9E4, 10C2, 11D2), gray with pink tinges (5YR 2/5–6) or grayish-brown (5D2-3, 5E3, 6C2, 6D2–3), occasionally pale orange-brown (5YR 3–4/3–4) or pale orange (7B5), whitish, pale vinaceous or pale vinaceous-brown towards or on the margin, often with obscure concentric zones. Stipe as an attenuated end of the hymenophore attached to the substratum, at times with age becoming poorly defined, around 15–25 × 15–30 mm, more or less cylindrical to attenuate, stout, velutinous, somewhat hirsute to glabrous at base, same color with pileus or hymenophore, whitish at base, compact. Context pale to more or less grayish-white, often with pale vinaceous or pink tinges, showing concentric growth lines, dry, fibrous, unchanging on exposure, 6–21 mm thick in pileus. Odor strong, almost farinaceous (recalling some stipitate hydnoids), taste mild.

Basidiospores 8–13 × (5.5–)6–9 µm, (*Xr* = 9.1–11.5 × 6.8–7.4 µm; *Qr* = 1.28–1.58), ellipsoid to broadly ellipsoid, some subglobose, at times adaxially weakly depressed, apiculus conspicuous, more or less truncate, thin-walled, smooth, hyaline, guttulate, germination not observed. Basidia 14–18 × 9–12 µm, ovate to obovate, at times clavate or subglobose, forming 2–4 basidial segments, clampless, guttulate; epibasidia cylindric or faintly tapered apically, up to 45 × 2–4 µm; fertile hyphae faintly tortuous, usually branching, forming basidia by proliferating near subbasidial hyphal segment. Dikaryophyses simple to shortly branched, 2–4 µm diam., guttulate, abundant, not forming a distinct layer above the basidia; the basal portion of the hymenial elements consisting of cylindrical, septate and compactly arranged hyphae; the general aspect of the hymenial stratum is of a gelatinous tissue, with its elements very compactly arranged and with refractive contents, more or less differentiated into several growth layers, each consisting of prostrate and ascending elements. Context consisting of cylindric, yellowish-brown or pale brown hyphae, 3–5(–9) µm wide, simple or bifurcate, shortly or more or less spacing segmented, thick-walled, loosely interwoven or in some areas with many hyphae arranged in tight fascicles forming a compact tissue; a narrow, prostrate layer composed of indistinct, agglutinated hyphae giving rise to the hymenial elements. Clamp connections absent.

Ecology— Scattered or gregarious (occasionally solitary) in soil, commonly among fallen dead leaves and twigs, the basidiomes often enclosing small, dead twigs or thin stalks of live plants, in tropical deciduous *Gymnopodium floribundum* forest.

Material studied — **MEXICO**. **Chiapas**: Suchiapa, Mpio. de Suchiapa, 4.XI.2003, *Bandala 3838*; 5.VII.2005, *Montoya 4353*; 5.IX.2006, Bandala *4210*, *4212* (GenBank JQ012947); 14.VI.2008, *Bandala 4361*, *4363*; 15.VI.2008, *Bandala 4366*, *4370*, *4374* (all at XAL). **JAMAICA**. Troy and Tyre, Cockpit Country, *W.A. Murrill & W. Harris* (Fungi of Jamaica 1087) (Holotype, NY).

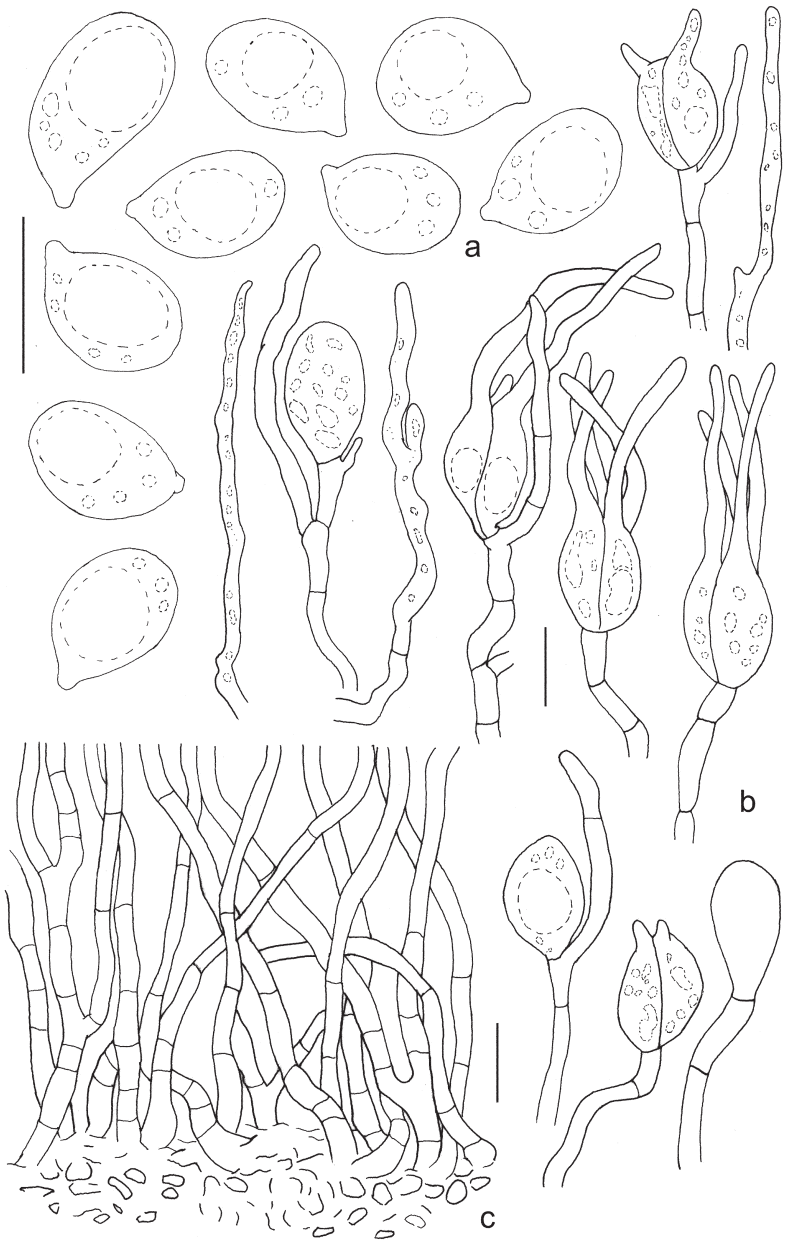

Plate 3. *Tremelloscypha gelatinosa*.
a. Basidiospores. b. Basidia and dikaryophyses. c. Section of basal portion of hymenium. (Bandala 4210). Scale bar = 10 μm

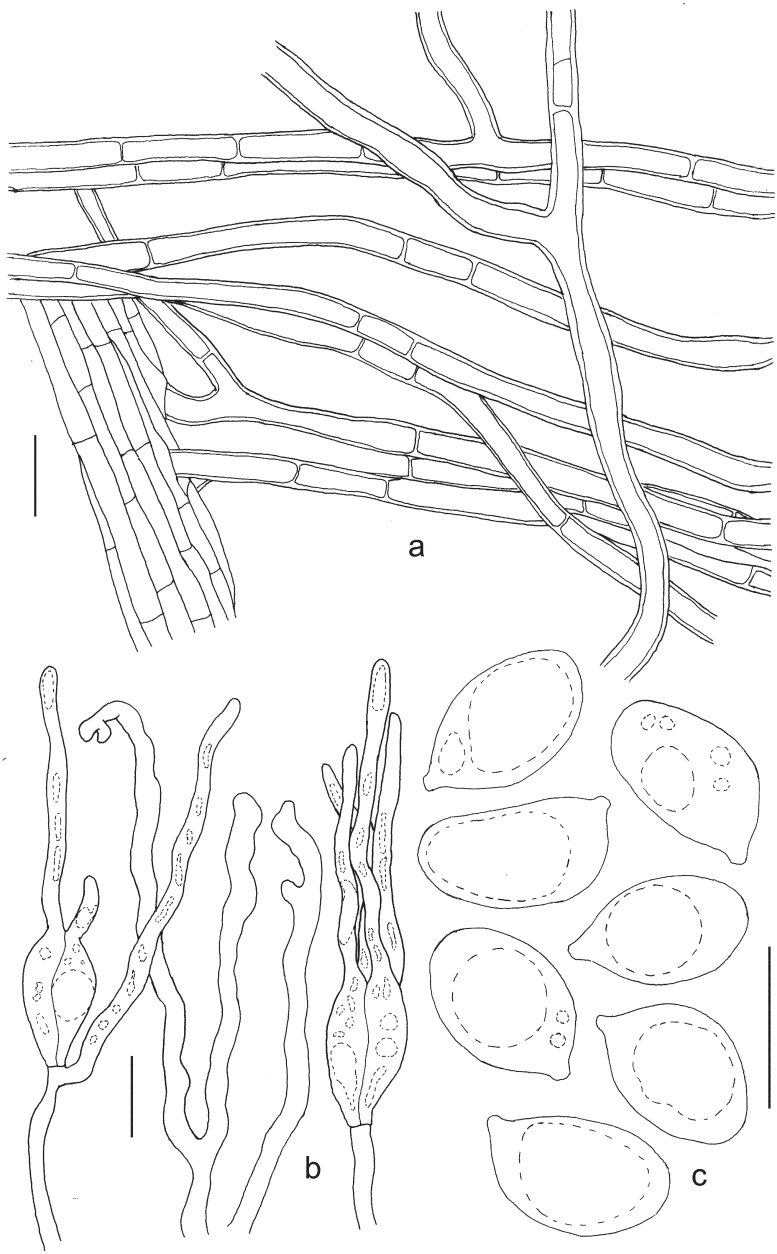

Plate 4. *Tremelloscypha gelatinosa*.
a. Context hyphae. b. Basidia and dikaryophyses. c. Basidiospores.
(a: Bandala 4210; b–c: Bandala 4274). Scale bar = 10 μm.

Discussion

Recognition of *Tremelloscypha gelatinosa* as a non-resupinate fungus (i.e. different from members of *Eichleriella* Bres.; cf. Wells & Raitviir 1980) was inferred not from the type but from a specimen from Florida gathered by K. Lampe & A.L. Welden in 1957 (Wells 1961). The holotype (from Jamaica) in fact consists of only a pressed 35 × 18 mm portion apparently separated from the rest of the basidiome and superficially bearing a resemblance to an effuse-reflexed fructification as indicated both by the diagnosis (Burt 1915) and the field label accompanying the type noting "a specimen of *Stereum* or *Cladoderris*." Using data from the previously cited Florida collection and microscopic examination of the holotype, Wells & Oberwinkler (1982) recorded *T. gelatinosa* as growing on decayed wood and described the basidiomes as 35–75 × 20–55 mm, 1–6 mm thick, flabellate, infundibuliform or pseudoinfundibuliform in shape, and with a poorly defined stipe.

Our fresh collections covered many different developmental stages, thus providing more information on the variability of the gross morphology. The fructifications were irregularly subglobose, pulvinate, lacking a stipe or rudimentarily stipitate and pseudoinfundibuliform, more or less trumpet-shaped and sometimes flabellate or spathulate, not with umbilicate, depressed or deeply depressed pileus, in some stages the sporophores then superficially resembled polyporoid, stipitate-steroid or gomphoid forms.

Sporophores of both *T. australiensis* D.A. Reid, the type species of the genus (Reid 1979), and our *T. gelatinosa* collections grew on soil, not wood. *Tremelloscypha australiensis* differs morphologically from *T. gelatinosa* in its smaller (7–20 × 8–12 mm) distinctly infundibuliform stipitate basidiomes that are yellow when fresh and yellowish- or ochraceous-brown when dry and a pileus surface with an almost waxy-cartilaginous appearance (Reid 1979). Spore characters are particularly important: *T. australiensis* basidiospores are subcylindrical, narrowly elliptical to suballantoid (Reid 1982: 10–13.2 × 4.5–5 µm; Wells & Oberwinkler 1982: 10.5–13 × 5–5.5 µm), while *T. gelatinosa* basidiospores are ellipsoid to broadly ellipsoid (Burt 1915: 8–10 × 6 µm; Wells 1961: 7.5–11 × 5.5–8 µm; Wells & Oberwinkler 1982: 9–13.5(–14.5) × 5.5–8(–9.5) µm; Guzmán 2004: (7–)9–13 × 6–8 µm; this study: 8–13 × (5.5–)6–9 µm).

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